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Used as an herbicide, defoliant and silvicide. See also arsenic compounds.
Disaster Hazard: Hazardous when water solution is in contact with active metals, i.e. Fe, Al, and Zn or when heated to decomposition.
Countermeasures
Storage and Handling: Section 7.
Shipping Regulations: *Section 11.*
Regulated by CG, DOT, IATA.

CACODYL OXIDE
General Information
Synonym: dicacodyl oxide.
Colorless liquid, slighly sol. in water.
Formula: $O[(CH_3)_2As]_2$.
Mol wt: 226, d: 1.486 at 15°C, mp: −25°C, bp: 150°C
Hazard Analysis
Toxicity: Highly toxic. A recognized carcinogen, See tion 8. An herbicide. See arsenic compounds.
Disaster Hazard: See cacodyl dioxide.

CACODYL SULFIDE
General Information
Synonym: dicacodyl sulfide.
Oily liquid slightly sol. in water.
Formula: $[(CH_3)_2As]_2S$.
Mol wt: 242, bp: 211°C.
Hazard Analysis
Toxicity: A recognized carcinogen, see Section 8. An herbicide. See arsenic compounds and sulfides.
Fire Hazard: Dangerous, when exposed to heat or by spontaneous chemical reaction. Ignites spontaneously in air (Section 7).
Spontaneous Heating: Yes.
Explosion Hazard: Unknown.
Disaster Hazard: Dangerous; see arsenic and oxides of sulfur; it can react vigorously with oxidizing materials.
Countermeasures
Personal Hygiene: Section 7.
Storage and Handling: Section 7.

CADAVERINE. See pentamethylene diamine.

CADE OIL
General Information
Synonym: juniper tar.
Dark brown, viscous volatile oil.
D: 0.950–1.055 at 25°/25°C.
Hazard Analysis
Toxicity: An allergen.
Fire Hazard: A combustible material; can react with oxidizing materials (Section 7).
Countermeasures
Personal Hygiene: Section 2.
Storage and Handling: Section 7.

CADMIUM *
General Information
Hexagonal crystals; silver-white malleable metal.
Formula: Cd.
At wt: 112.41, mp: 320.9°C, bp: 767± 2°C, d: 8.642
vap. press.: 1 mm at 394°C.

Note: For an in-depth discussion of storage and handling

Hazard Analysis
Radiation Hazard: For permissible levels see Section 5, Table 5. Artificial isotope, ^{105}Cd, $T\frac{1}{2}$ = 450 d, decays to stable ^{105}Ag via ec. Emits γ's of 0.09 MeV. Artificial isotope ^{115m}Cd, $T\frac{1}{2}$ = 43 d, decays to ^{115}In via β's of 1.6 MeV. Artificial isotope ^{115}Cd, $T\frac{1}{2}$ = 54 h, decays to ^{115}In via β's of 0.58, 0.86, 1.11 MeV. Also γ's of 0.26–0.53 MeV.
Toxicity: See cadmium compounds.
Fire Hazard: Moderate, in the form of dust when exposed to heat or flame or by chemical reaction with oxidizing agents (Section 7). See also powdered metals.
Explosion Hazard: Slight, in the form of dust when exposed to flame (Section 7).
Disaster Hazard: Dangerous; Cd dust; can react vigorously with oxidizing materials.
Countermeasures
Ventilation Control: Section 2.
Personal Hygiene: Section 2.
Storage and Handling: Section 7.

CADMIUM ACETATE
General Information
Monoclinic colorless crystals, odor of acetic acid.
Formula: $Cd(C_2H_3O_2)_2$.
Mol wt: 230.50, mp: 256°C, bp: decomposes, d: 2.341.
Hazard Analysis and Countermeasures
See cadmium compounds.

CADMIUM ALLOYS
See cadmium compounds.

CADMIUM AMIDE
General Information
White solid.
Formula: $Cd(NH_2)_2$.
Mol wt: 144.46, mp: decomposes at 120°C, d: 3.05 at 25°C.
Hazard Analysis and Countermeasures
See cadmium compounds and ammonia.

CADMIUM AMMONIUM BROMIDE
General Information
Synonyms: ammonium-cadmium bromide.
Colorless crystals.
Formula: $CdBr_2 \cdot 4NH_4Br$.
Mol wt: 664.00.
Hazard Analysis and Countermeasures
See cadmium compounds and bromides.

CADMIUM ARSENIDE
General Information
Dark-gray cubes.
Formula: Cd_3As_2.
Mol wt: 487.05, mp: 721°C, d: 6.21 at 15°/4°C.
Hazard Analysis
Toxicity: A recognized carcinogen, Section 8. See As compounds and Cd compounds.
Fire Hazard: Moderate, when exposed to heat or flame. May evolve arsine upon contact with moisture or acids (Section 7).
Explosion Hazard: Moderate, when exposed to flame (Section 7). See also arsine.
Disaster Hazard: Dangerous; when heated to decomposition or on contact with acids, it emits highly toxic fumes which will react violently with water, steam or oxidizing materials.
Countermeasures
Personal Hygiene: Section 2.
Storage and Handling: Section 7.

CADMIUM BENZOATE
General Information
White solid.
Formula: $Cd(C_7H_5O_2)_2 \cdot 2H_2O$.
Mol wt: 390.66.
Hazard Analysis and Countermeasures
See cadmium compounds.

CADMIUM BOROTUNGSTATE
General Information
Yellow triclinic crystals.
Formula: $Cd_3(BW_{12}O_{40})_2 \cdot 18H_2O$.
Mol wt: 6602.06, mp: 75°C.
Hazard Analysis and Countermeasures
See cadmium compounds and borotungstates.

CADMIUM BROMATE
General Information
Rhombic white crystals.
Formula: $Cd(BrO_3)_2 \cdot H_2O$.
Mol wt: 386.26, mp: decomposes, d: 4.758
Hazard Analysis
Toxicity: See cadmium compounds and bromates.
Fire Hazard: Moderate, by chemical reaction with reducing agents (Section 7).
Caution: A powerful oxidizing agent.
Disaster Hazard: Dangerous; see cadmium, bromine and bromides; it can react violently with reducing materials.
Countermeasures
Storage and Handling: Section 7.

CADMIUM BROMIDE
General Information
Yellow crystals.
Formula: $CdBr_2$.
Mol wt: 272.24, mp: 567°C, bp: 863°C, d: 5.192 at 25°C.
Hazard Analysis and Countermeasures
See cadmium compounds and bromides.

CADMIUM CARBONATE
General Information
Trigonal, white crystals.
Formula: $CdCO_3$.
Mol wt: 172.42, mp: decomposes 500°C, d: 4.258 at 4°C.
Hazard Analysis and Countermeasures
See cadmium compounds.

CADMIUM CHLORATE
General Information
Colorless, deliquescent prisms.
Formula: $Cd(ClO_3)_2 \cdot 2H_2O$.
Mol wt: 315.36, mp: 80°C, d: 2.2
Hazard Analysis
Toxicity: See cadmium compounds and chlorates.
Fire Hazard: Moderate, by chemical reaction with reducing agents (Section 7).
Caution: A powerful oxidizing agent. See also chlorates.
Explosion Hazard: Moderate, when shocked or exposed to heat. See also chlorates.

TOXIC HAZARD RATING CODE (For detailed discussion, see Section 9.)

0 NONE: (a) No harm under any conditions; (b) Harmful only under unusual conditions or overwhelming dosage.
1 SLIGHT: Causes readily reversible changes which disappear after end of exposure.
2 MODERATE: Causes irreversible changes not severe enough to cause death or permanent injury.
3 HIGH: May cause death or permanent injury after very short exposure to small quantities.
U UNKNOWN: No information on humans considered

Disaster Hazard: Dangerous; heat and shock will explode it; see cadmium, chlorine, and chlorides; it can react vigorously with reducing materials.
Countermeasures
Personal Hygiene: Section 2.
Storage and Handling: Section 7.

CADMIUM CHLORIDE
General Information
Hexagonal, colorless crystals.
Formula: $CdCl_2$.
Mol wt: 183.32, mp: 568°C, d: 4.047 at 25°C, vap. press.: 10 mm at 656°C, bp: 960°C.
Hazard Analysis and Countermeasures
See cadmium compounds and chlorides.

CADMIUM COBALTINITRITE. See cadmium nitrocobaltate (III).

CADMIUM COMPOUNDS
Hazard Analysis
Toxic Hazard Rating:
Acute Local: Irritant 3; ingestion 3; Inhalation 3.
Acute Systemic: Ingestion 3; Inhalation 3.
Chronic Local: Variable.
Chronic Systemic: Ingestion 3; Inhalation 3.
Toxicology: The oral toxicity of Cd and its compounds is high. However, when these materials are ingested, the irritant and emetic action is so violent that little of the Cd is absorbed and fatal poisoning does not as a rule ensue. The oral LD_{50} (rat) ranges from 14 mg/kg for Cd lactate to 660 mg/kg for Cd succinate. Cases of human Cd poisoning have been reported from ingestion of food or beverages prepared or stored in Cd-plated containers. The inhalation of fumes or dusts of cadmium primarily affects the respiratory tract; the kidneys may also be affected. Even brief exposure to high concentrations may result in pulmonary edema and death. Uusually the edema is not massive, with little pleural effusion. In fatal cases, fatty degeneration of the liver, and acute inflammatory changes in the kidneys have been noted. Ingestion of cadmium results in a gastro-intestinal type of poisoning resembling food poisoning in its symptoms.

Inhalation of dust or fumes may cause dryness of the throat, cough, headache, a sense of constriction in the chest, shortness of breath (dyspnea) and vomiting. More severe exposure results in marked lung changes, with persistent cough, pain in the chest, severe dyspnea and prostration which may terminate fatally. X-ray changes are usually similar to those seen in broncho-pneumonia. The urine is frequently dark. These symptoms are usually delayed for some hours after exposure, and fatal concentrations may be breathed without sufficient discomfort to warn the workman to leave the exposure. See also cadmium. Cadmium compounds are recognized carcinogens. (Section 8) of the connective tissue, lungs and liver.

Ingestion of cadmium results in sudden nausea, salivation, vomiting and diarrhea and abdominal pain and discomfort. Symptoms begin almost immediately after ingestion.

[illegible] yellow discoloration of the teeth has been reported in workers exposed to cadmium. Cadmium oxide fumes can cause metal fume fever [illegible] that caused by zinc oxide fumes.
Countermeasures
Ventilation Control: Section 2.
Personal Hygiene: Section 2.
Storage and Handling: Section [illegible]

[illegible]

[illegible] ACGIH. See complete reprint of TLVs in Section 1. [illegible]

CADMIUM CYANIDE
General Information
Crystals.
Formula: $Cd(CN)_2$.
Mol wt: 164.45, mp: > 200°C decomposes, d: 2.226.
Hazard Analysis and Countermeasures
See cyanides and cadmium compounds.

CADMIUM DIHYDROGEN PHOSPHATE
General Information
Triclinic crystals.
Formula: $Cd(H_2PO_4)_2 \cdot 2H_2O$.
Mol wt: 342.4, mp: decomposes 100°C, d: 2.74 at 15°/4°C.
Hazard Analysis and Countermeasures
See cadmium compounds and phosphoric acid.

CADMIUM-9,10-EPOXYSTEARATE
Hazard Analysis
Toxic Hazard Rating:
Acute Local: U.
Acute Systemic: Ingestion 2.
Chronic Local: U.
Chronic Systemic: U.
Based on limited animal experiments.
Disaster Hazard: Dangerous. See cadmium compounds.

CADMIUM ETHYLENE BISDITHIOCARBAMATE
Hazard Analysis
Toxicity: See cadmium compounds.
Disaster Hazard: Dangerous. See cadmium and oxides of sulfur.
Countermeasures
Storage and Handling: Section 7.

CADMIUM FERROCYANIDE
General Information
Solid.
Formula: $Cd_2Fe(CN)_6 \cdot xH_2O$.
Mol wt: 436.4 + × (18).
Hazard Analysis and Countermeasures
See cadmium compounds and ferrocyanides.

CADIUM FLUOGALLATE
General Information
Colorless crystals.
Formula: $[Cd(H_2O)_6](GaF_5H_2O)$.
Mol wt: 403.24, mp: $-5H_2O$ at 110°C, d: 2.79.
Hazard Analysis and Countermeasures
See fluorides and cadmium compounds.

CADMIUM FLUORIDE
General Information
Cubic white crystals.
Formula: CdF_2.
Mol wt: 150.41, mp: 1100°C, bp: 1758°C, d: 6.64, vap. press: 1 mm at 1112°C.
Hazard Analysis and Countermeasures
See fluorides and cadmium compounds.

CADMIUM FLUOSILICATE
General Information
Hexagonal, colorless crystals.
Formula: $CdSiF_6 \cdot 6H_2O$.
Mol wt: 362.6.
Hazard Analysis and Countermeasures
See cadmium compounds and fluosilicates.

CADMIUM FORMATE
General Information
Monoclinic crystals.
Formula: $Cd(CHO_2)_2 \cdot 2H_2O$.
Mol wt: 238.45, mp: decomposes [illegible]

[illegible]

Note: For an in-depth discussion [illegible] and control of fires see Section [illegible]

...ling: Section 7.

...dichloroethyl ether.

...FOS

...ro-1-(2,4-dichlorophenyl)-vinyl diethyl

...PCl_2

...cholinesterase inhibitor. Acute oral LD_{50} ... mg/kg. Acute dermal LD_{50} (rabbit) ... mg/kg.

...IDE

...chlorophenyl)-5-isopropylbiguanide hy-...

...$H_4C_6H_4C_2H_5N_5HCl$.
...: 244°C.

...(rats) = 200 mg/kg.
...Dangerous; see chlorides.

...dling: Section 7.

...ROL

...ium chlorohydroxide complex.

...Probably has low toxicity.

...H_2O.
...: < −20°C, bp: decomposes 40°C,

...(See also chlorates).
...3; Ingestion 3; Inhalation 3.

...ignites organic matter upon ... oxidizing agent.

...; see chlorides; reacts vig-... materials.

Acute Local: U.
Acute Systemic: Ingestion 3; Inhalation 3; Skin Absorption 2.
Chronic Local: Irritant 2; Ingestion 2; Inhalation 2.
Chronic Systemic: Ingestion 1; Inhalation 1; Skin Absorption 1.

Fire Hazard: Moderate, when exposed to heat or flame (Section 7).

Disaster Hazard: Dangerous; when heated to decomposition, it emits highly toxic fumes of phosgene; can react vigorously with oxidizing materials.

Countermeasures

Ventilation Control: Section 2.
Personnel Protection: Section 2.
Storage and Handling: Section 7.

CHLORIDE OF LIME. See bleaching powder.

CHLORIDES

Hazard Analysis

Toxicity: Varies widely. Sodium chloride (table salt) has very low toxicity, while carbonyl chloride (phosgene) is lethal in small doses.

Disaster Hazard: Dangerous; when heated to decomposition or on contact with acids or acid fumes they evolve highly toxic chloride fumes. Some organic chlorides decompose to yield phosgene.

Countermeasures

Storage and Handling: Section 7.

CHLORINATED ANTHRACENE OIL. See carbolineum.

CHLORINATED BIPHENOLS. See chlorinated diphenyls.

CHLORINATED CAMPHENE. * See "Toxaphene."

CHLORINATED DIPHENYL OXIDE *

Hazard Analysis

Toxic Hazard Rating:
Acute Local: Irritant 2.
Acute Systemic: Ingestion 3; Inhalation 3.
Chronic Local: Irritant 3.
Chronic Systemic: Inhalation 3; Skin Absorption 2.

Disaster Hazard: Dangerous; when heated to decomposition, it emits highly toxic fumes.

Countermeasures

Storage and Handling: Section 7.

CHLORINATED DIPHENYLS *

General Information

Synonym: PCB
Colorless mobile liquid.
Bp: 340–375°C, flash p.: 383°F (C.O.C.), d: 1.44 at 30°C.

Hazard Analysis

Toxic Hazard Rating:
Acute Local: Irritant 3.
Acute Systemic: Ingestion 3; Inhalation 3; Skin Absorption 3.
Chronic Local: Irritant 3.
Chronic Systemic: Inhalation 3; Skin Absorption 2.

Toxicology: Like chlorinated naphthalenes it displays high acute and chronic local toxicity. Its systemic effect is mainly upon the liver causing an acute yellow atrophy. This hepatotoxic action of chlorinated diphenyls appears to be ... [illegible]

compound, the more toxic it is liable to be. Oxides of chlorinated diphenyls are more toxic than the unoxidized materials.

The skin lesion is known as chloracne, and consists of small pimples and dark pigmentation of the exposed areas, initially. Later comedones and pustules develop. In persons who have suffered systemic intoxication the usual signs and symptoms are nausea, vomiting, loss of weight, jaundice, edema and abdominal pain. Where the liver damage has been severe the patient may pass into coma and die. A recognized mutagen and potential carcinogen, see Section 8.

Fire Hazard: Slight, when exposed to heat or flame (Section 7).

Disaster Hazard: Dangerous; when heated to decomposition, they emit highly toxic fumes.

Countermeasures

Ventilation Control: Section 2.
Personnel Protection: Section 2.
First Aid: Section 9.
Storage and Handling: Section 7.

CHLORINATED HYDROCARBONS, ALIPHATIC

Hazard Analysis

Toxicology: The substitution of a Cl (or other halogen) atom for a hydrogen greatly increases the anesthetic action of a member of the aliphatic hydrocarbons. In addition, the chlorine derivative is usually less specific in its action and may affect other tissues of the body in addition to those of the central nervous system; in many cases the chlorine derivative is quite toxic. Thus, chloroform, in addition to its narcotic qualities, may cause liver, heart, and kidney damage.

As a general rule, the unsaturated chlorine derivatives are highly narcotic but less toxic than the saturated derivatives, thus causing degenerative changes in the liver and kidneys less frequently. In the saturated group, the narcotic effect is enhanced with an increase in the number of chlorine atoms. However, there is less relationship between the number of chlorine atoms present and the toxicity of the compound.

In dealing with these chlorinated HC, it must be remembered that a toxic action may result from repeated exposure to concentrations which are too low to produce a narcotic effect, and which, consequently, are too low to give warning of danger. Individual susceptibility is also important when poisoning by this group of solvents is being considered. Certain workmen may be seriously affected by concentrations that seem to have no effect on fellow employees in the same exposure. A suspected carcinogen of the liver, lung, skin and blood forming tissues, Section 8.

Disaster Hazard: Dangerous; when heated to decomposition, they emit highly toxic fumes of phosgene; they can react with oxidizing materials.

Countermeasures

Storage and Handling: Section 7.

CHLORINATED HYDROCARBONS, AROMATIC

Hazard Analysis

Toxicology: In most instances it is difficult to predict the toxicity of these compounds. However, in the case of most aromatic chlorine compounds, their toxicity is usually no greater, and frequently is less, than that of the corresponding aromatic hydrocarbons, with the notable exception of naphthalene. Suspected carcinogens, Section 8.

Fire Hazard: Unknown.

Explosion Hazard: Unknown.

Disaster Hazard: Dangerous; when heated to decomposition, they emit toxic fumes; they can react with oxidizing materials.

Countermeasures

Storage and Handling: Section 7.

CHLORINATED HYDROCHLORIC ETHER. See ethylidene chloride.

CHLORINATED LIME. See bleaching powder.

CHLORINATED NAPHTHALENES

Hazard Analysis

Toxic Hazard Rating:
Acute Local: Irritant 3.
Acute Systemic: Ingestion 3; Inhalation 3.
Chronic Local: Irritant 3.
Chronic Systemic: Ingestion 3; Inhalation 3; Skin Absorption 3.

Toxicology: The action of the chlorinated naphthalenes on the body is quite similar to that of the chlorinated diphenyls, the chief effects being the production of chloracne of the skin and, systemically, acute yellow atrophy of the liver. See also suspected carcinogens, Section 8 chlorinated diphenyls.

Disaster Hazard: Dangerous; see chlorides.

Countermeasures

Ventilation Control: Section 2.
Personnel Protection: Section 2.
Personal Hygiene: Section 2.
Storage and Handling: Section 7.

CHLORINATED PHENOLS

Hazard Analysis

Toxic Hazard Rating:
Acute Local: Irritant 3; Ingestion 3; Inhalation 3.
Acute Systemic: Ingestion 3; Inhalation 3; Skin Absorption 3.
Chronic Local: U.
Chronic Systemic: Ingestion 3; Inhalation 3; Skin Absorption 3.

Disaster Hazard: Dangerous; when heated to decomposition, they emit highly toxic fumes.

Countermeasures

Storage and Handling: Section 7.
Ventilation and Industrial Hygiene: Section 2.
Respiratory Protection: Section 2.

CHLORINATED TRIPHENYLS

Hazard Analysis

Toxic Hazard Rating:
Acute Local: Irritant 2.
Acute Systemic: Ingestion 2; Inhalation 2; Skin Absorption 2.
Chronic Local: Irritant 3.
Chronic Systemic: Ingestion 2; Inhalation 2; Skin Absorption 2.

See also chlorinated diphenyls.

Disaster Hazard: Dangerous; when heated to decomposition, they emit highly toxic fumes of chlorine.

Countermeasures

Ventilation Control: Section 2.
Personnel Protection: Section 2.
Personal Hygiene: Section 2.
Storage and Handling: Section 7.

CHLORINE *

General Information

Greenish-yellow gas, liquid, or rhombic crystals.
Formula: Cl_2
Mol wt: 70.914, mp: −101°C, bp:

* This material has been assigned a Threshold Limit Value by ACGIH. See complete reprint of TLV's in Section 1.

...for in-depth discussion of ... and control of fires see Section 7.

… Hazard: Dangerous; when heated to decomposition, it emits toxic fumes; can react with oxidizing materials.

…and Handling: Section 7.

…YL MERCAPTAN

…Information

…: dodecyl mercaptan.

…white to pale yellow liquid.

…: $C_{12}H_{25}SH$.

…wt: 202.5, mp: −7°C, bp: 115–177°C, flash p.: …262°F, d: 0.849 at 15.5°/15.5°C.

…Analysis and Countermeasures

…ercaptans.

…YL PYRIDINIUM CHLORIDE

…Information

…: dodecyl pyridinium chloride.

…d tan semi-solid.

…: $C_5H_5NC_{12-4}H_{24-2}Cl$.

…wt: 292.0, flash p.: 347°F.

…Analysis

…ity: Unknown.

…Hazard: Slight, when exposed to heat or flame.

…er Hazard: Moderately dangerous; when heated to decomposition, it emits toxic fumes; can react with oxidizing materials.

…ermeasures

…ge and Handling: Section 7.

…ght Fire: Foam, carbon dioxide, dry chemical or carbon tetrachloride (Section 7).

…YL QUINALDINIUM BROMIDE

…Analysis

…: Details unknown. See also bromides.

…Hazard: Unknown.

…er Hazard: Dangerous; see bromides.

…ermeasures

…and Handling: Section 7.

…YL QUINOLINIUM CHLORIDE

…Analysis

…ity: Details unknown; a fungicide.

…azard: Unknown.

…er Hazard: Dangerous; see chlorides.

…ermeasures

…and Handling: Section 7.

…YL THIOCYANATE

…Information

…: $CH_3(CH_2)_{10}CH_2SCN$.

…: 227.3.

…Analysis and Countermeasures

…cyanates. An insecticide.

…NCITE: See ferrous chloride.

…NCIUM

…Information

… transuranium element of atomic No. 103 … atomic mass No. 257.

… Hazard: Intensely radioactive, and therefore … toxic element.

LEACHATE PRODUCTION FROM SOLID WASTE. Section 6.

LEAD *

General Information

Synonym: plumbum.

Bluish-gray, soft metal.

Formula: Pb.

At wt: 207.21, mp: 327.43°C, bp: 1620°C, d. 11.288 at 20°/20°C, vap. press.: 1 mm at 973°C.

Hazard Analysis

Toxic Hazard Rating:

Acute Local: 0.

Acute Systemic: Inhalation 3.

Chronic Local: 0.

Chronic Systemic: Ingestion 3; Inhalation 3.

Toxicology: See lead compounds. A common air contaminant. It is a suspected carcinogen of the lungs and kidney (Section 8).

Radiation Hazard: For permissible levels, see Section 5, Table 5. Artificial isotope ^{203}Pb, T½ = 52h. Decays to stable ^{203}Tl by electron capture. Emits γ's of 0.40 MeV and X-rays. Natural isotope ^{210}Pb (Radium-D, Uranium Series), T½ = 21y. Decays to radioactive ^{210}Bi by emitting β's of 0.015 (81%), 0.061 (19%) MeV. Also emits γ's of 0.046 MeV. ^{210}Pb usually exists in equilibrium with its daughters ^{210}Bi and ^{210}Po. Natural isotope ^{212}Pb (Thorium-B, Thorium Series), T½ = 10.6h. Decays to radioactive ^{212}Bi by emitting β's of 0.16 (5%), 0.34 (81%), 0.58 (14%) MeV. Also emits γ's of 0.24, 0.30 MeV and X-rays.

Fire Hazard: Moderate, in the form of dust when exposed to heat or flame. See also powdered metals.

Explosion Hazard: Moderate, in the form of dust when exposed to heat or flame.

Disaster Hazard: Dangerous; when heated it emits highly toxic fumes; can react vigorously with oxidizing materials.

Countermeasures

Ventilation Control: Section 2.

Personal Hygiene: Section 2.

Storage and Handling: Section 7.

LEAD ACETATE

General Information

Synonym: sugar of lead.

White crystals, sol. in water. Commercial grades are frequently brown or gray lumps.

Formula: $Pb(C_2H_3O_2)_2 \cdot 3H_2O$.

Mol wt: 379.35, mp: 75°C; anhydrous 280°C, d: 2.55.

Hazard Analysis and Countermeasures

A suspected carcinogen (Section 8). See lead compounds.

An insecticide.

Shipping Regulations: Section 11.

Regulated by IATA.

LEAD ACETATE, MONOBASIC

General Information

White powder.

Formula: $Pb_2OH(C_2H_3O_2)_3$.

Mol wt: 608.6.

Hazard Analysis and Countermeasures

See lead compounds.

LEAD ANTIMONATE

General Information

TOXIC HAZARD RATING CODE (For detailed discussion, see Section 9.)

… No harm under any conditions; (b) Harmful … unusual conditions or overwhelming dosage. … readily reversible changes which dis… end of exposure. … ATE: May involve both irreversible and reversible changes not severe enough to cause death or permanent injury. 3 HIGH: May cause death or permanent … short exposure to small quantities. U UNKNOWN: No information on humans … valid by authors.

Formula: $PbCl_2$.
Mol wt: 278.12, mp: 501°C, bp: 954°C, d: 5.85, vap. press.: 1 mm at 547°C.
Hazard Analysis and Countermeasures
See lead compounds.
Shipping Regulations: Section 11.
Regulated by IATA.

LEAD CHLORITE
General Information
Monoclinic, yellow crystals.
Formula: $Pb(ClO_2)_2$.
Mol wt: 342.12, mp: explodes at 126°C.
Hazard Analysis and Countermeasures
See lead compounds and chlorites.

LEAD CHROMATE
General Information
Synonyms: crocoite; chrome yellow.
Yellow crystals.
Formula: $PbCrO_4$.
Mol wt: 323.22, mp: 844°C, bp: decomposes, d: 6.3.
Hazard Analysis and Countermeasures
A recognized carcinogen (Section 8). See chromate compounds. See also lead and chromium compounds.

LEAD CHROMATE, BASIC
General Information
Red, amorphous or crystals.
Formula: $Pb_2(OH)_2CrO_4$.
Mol wt: 564.45, mp: 920°C.
Hazard Analysis
Toxicity: See lead and chromium compounds. A recognized carcinogen (Section 8).
Fire Hazard: Moderate, by chemical reaction with reducing agents.
Disaster Hazard: Dangerous, when heated to decomposition, it emits highly toxic fumes of lead and can react vigorously with reducing material.
Countermeasures
Storage and Handling: Section 7.

LEAD CITRATE
General Information
White, crystalline powder.
Formula: $Pb_3(C_6H_5O_7)_2 \cdot 3H_2O$.
Mol wt: 1053.88.
Hazard Analysis and Countermeasures
See lead compounds.

LEAD COMPOUNDS *
Hazard Analysis
Toxic Hazard Rating:
Acute Local: 0.
Acute Systemic: Ingestion 3; Inhalation 3.
Chronic Local: 0.
Chronic Systemic: Ingestion 3; Inhalation 3; Skin Absorption 3.
Toxicology: Lead poisoning is one of the commonest of occupational diseases. The presence of lead-bearing materials or lead compounds in an industrial plant does not necessarily result in exposure on the part of the workman. The lead must be in such form, and so distributed, as to gain entrance into the body or tissues of the workman in measurable quantity, otherwise no exposure can be said to exist. It is a suspected carcinogen of the lungs and kidneys (Section 8).

Mode of entry into body:
1. By inhalation of the dusts, fumes, mists or vapors. (Common air contaminants).
2. By ingestion of lead compounds trapped in the upper respiratory tract or introduced into the mouth on food, tobacco, fingers or other objects.
3. Through the skin; this route is of special importance in the case of organic compounds of lead, as lead tetraethyl. In the case of the inorganic forms of lead, this route is of no practical importance.

Physiological Action and Toxicity: When lead is ingested, much of it passes through the body unabsorbed, and is eliminated in the feces. The greater portion of the lead that is absorbed is caught by the liver and excreted, in part, in the bile. For this reason, larger amounts of lead are necessary to cause poisoning if absorption is by this route, and a longer period of exposure is usually necessary to produce symptoms. On the other hand, when lead is inhaled, absorption takes place easily from the respiratory tract and symptoms tend to develop more quickly. From the point of view of industrial poisoning, inhalation of lead is much more important than is ingestion.

Lead is a cumulative poison. Increasing amounts build up in the body and eventually a point is reached where symptoms and disability occur.

Lead produces a brittleness of the red blood cells so that they hemolyze with but slight trauma; the hemoglobin is not affected. Due to their increased fragility, the red cells are destroyed more rapidly in the body than normally, producing an anemia which is rarely severe. The loss of circulating red cells stimulates the production of new young cells which, on entering the blood stream, are acted upon by the circulating lead, with resultant coagulation of their basophilic material. These cells after suitable staining, are recognized as "stippled cells." As regards the effect of lead on the white blood cells, there is no uniformity of opinion. In addition to its effect on the red cells of the blood, lead produces a damaging effect on the organs or tissues with which it comes in contact. No specific or characteristic lesion is produced. Autopsies of deaths attributed to lead poisoning and experimental work on animals, have shown pathological lesions of the kidneys, liver, male gonads, nervous system, blood vessels and other tissues. None of these changes, however, have been found consistently.

In cases of lead poisoning, the amount of lead found in the blood is frequently in excess of 0.07 mg per 100 cc of whole blood. The urinary lead excretion generally exceeds 0.1 mg per liter of urine.

The toxicity of the various lead compounds appears to depend upon several factors: (1) the solubility of the compound in the body fluids; (2) the fineness of the particles of the compound; solubility is greater, of course, in proportion to the fineness of the particles; (3) conditions under which the compound is being used; where a lead compound is used as a powder, contamination of the

[illegible]

TOXIC HAZARD RATING CODE (For detailed discussion, see Section 9.)

NONE: (a) No harm under any conditions; (b) Harmful only under unusual conditions or overwhelming dosage.
SLIGHT: Causes readily reversible [illegible] after end of exposure.
MODERATE: May involve both irreversible and reversible changes not severe enough to cause death or permanent injury.
HIGH: May cause death or permanent injury after very short exposure to small quantities.
UNKNOWN: No information on humans considered valid by authors.

atmosphere will be much less where the powder is kept damp. Of the various lead compounds, the carbonate, the monoxide and sulfate are considered to be more toxic than metallic lead or other lead compounds. Lead arsenate is very toxic, due to the presence of the arsenic radical.

Signs and Symptoms: Industrial lead poisoning commonly occurs following prolonged exposure to lead or its compounds. The common clinical types of lead poisoning may be classified according to their clinical picture as (a) alimentary; (b) neuromotor; and (c) encephalic. Some cases may show a combination of clinical types. The alimentary type occurs most frequently, and is characterized by abdominal discomfort or pain. Severe cases may present actual colic. Other complaints are constipation and/or diarrhea, loss of appetite, metallic taste, nausea and vomiting, lassitude, insomnia, weakness, joint and muscle pains, irritability, headache and dizziness. Pallor, lead line on the gums, pyorrhea, loss of weight, abdominal tenderness, basophilic stippling, anemia, slight albuminuria, increased urinary excretion, and an increase in the lead content of the whole blood, are signs which may accompany the above symptoms.

In the neuromuscular type, the chief complaint is weakness, frequently of the extensor muscles of the wrist and hand, unilateral or bilateral. Other muscle groups which are subject to constant use may be affected. Gastroenteric symptoms are usually present, but are not as severe as in the alimentary type of poisoning. Joint and muscle pains are likely to be more severe. Headache, dizziness and insomnia are frequently prominent. True paralysis is uncommon, and usually is the result of prolonged exposure.

Lead encephalopathy is the most severe but the rarest manifestation of lead poisoning. In the industrial worker it follows rapid and heavy lead absorption. Organic lead compounds, such as tetraethyl lead, are absorbed rapidly through the skin as well as through the lungs, and are selectively absorbed by the central nervous system. The clinical picture in these cases is usually an encephalopathy. With inorganic lead compounds, comparable concentrations in the central nervous system are reached only when the workplace is heavily contaminated with vapor, fume and dust. Encephalopathy begins abruptly, and is characterized by signs of cerebral and meningeal involvement. There is usually stupor, progressing to coma, with or without convulsion, and often terminating in death. Excitation, confusion and mania are less common. In milder cases of short duration, there may be symptoms of headache, dizziness, somnolence and insomnia. The cerebrospinal pressure may be increased. See also specific compound.

Diagnosis: A diagnosis of lead poisoning should not be made on the basis of any single clinical or laboratory finding. There must be a history of significant exposure, signs, and symptoms (as described above) compatible with the diagnosis, and confirmatory laboratory tests. Increase of stippled red blood cells, mild anemia, and elevated lead in blood and urine, i.e., more than 0.07 mg/100 ml blood and similar values per liter of urine. An increase of coproporphyrins and certain amino acids in urine may be present. Diagnostic mobilization of lead with calcium EDTA may be useful in questionable cases.

Treatment of Lead Poisoning: It has been found that the chelating agent, calcium ethylenediaminetetracetate, and related compounds are highly efficacious in removing absorbed lead from the tissues of the body. (The therapeutic agents of this group are also known as versene, versenate, edathamil and Ca EDTA.)

Ca EDTA is effective only when administered intravenously. Various dosage schedules have been proposed. An effective regime is 3 to 6 grams of Na Ca EDTA in 300 cc to 500 cc of 5 percent glucose by intravenous drip over a period of 3 to 8 hours. Treatment may be given daily for 5 to 10 days with an interval of one week between courses. Another plan is to give treatment at intervals of 3 to 5 days until deleading has been accomplished.

Disaster Hazard: See lead.

Countermeasures

Ventilation Control: Section 2.

Personal Hygieene: Section 2.

LEAD CYANATE

General Information

White needles.

Formula: $Pb(OCN)_2$.

Mol wt. 291.25, mp: decomposes.

Hazard Analysis and Countermeasures

See lead compounds and cyanates.

LEAD CYANIDE

General Information

White powder.

Formula: $Pb(CN)_2$.

Mol wt: 259.25.

Hazard Analysis and Countermeasures

See lead compounds and cyanides.

Shipping Regulations: Section 11.

Regulated by CG, DOT, IATA.

LEAD DI-*o*-ARSENATE. See lead arsenates.

LEAD DICHROMATE

General Information

Red crystals.

Formula: $PbCr_2O_7$.

Mol wt: 423.23.

Hazard Analysis

Toxicity: See lead and chromium compounds. A recognized carcinogen (Section 8).

Fire Hazard: Moderate, by chemical reaction with reducing agents (Section 7).

Disaster Hazard: Dangerous; see lead; can react vigorously with reducing materials.

Countermeasures

Storage and Handling: Section 7.

LEAD DICYANOGUANIDINE

General Information

Crystals.

Formula: $Pb[NH_2CN(NCN)CN]_2$.

Mol wt: 423.4, mp: > 300°C.

Hazard Analysis

Toxicity: This material may be quite toxic by skin absorption. See also lead compounds.

Disaster Hazard: Dangerous; see lead and cyanides.

Countermeasures

Storage and Handling: Section 7.

LEAD DIIODIDE

General Information

Golden-yellow crystals or powder.

Formula: PbI_2.

Mol wt: 461.05, mp: 402°C, bp: 954°C, d: 6.16.

Note: For an in-depth discussion of storage and handling and control of fires see Section 7.

This material has been assigned a Threshold Limit Value by ACGIH. See complete reprint of TLV's in Section 1.